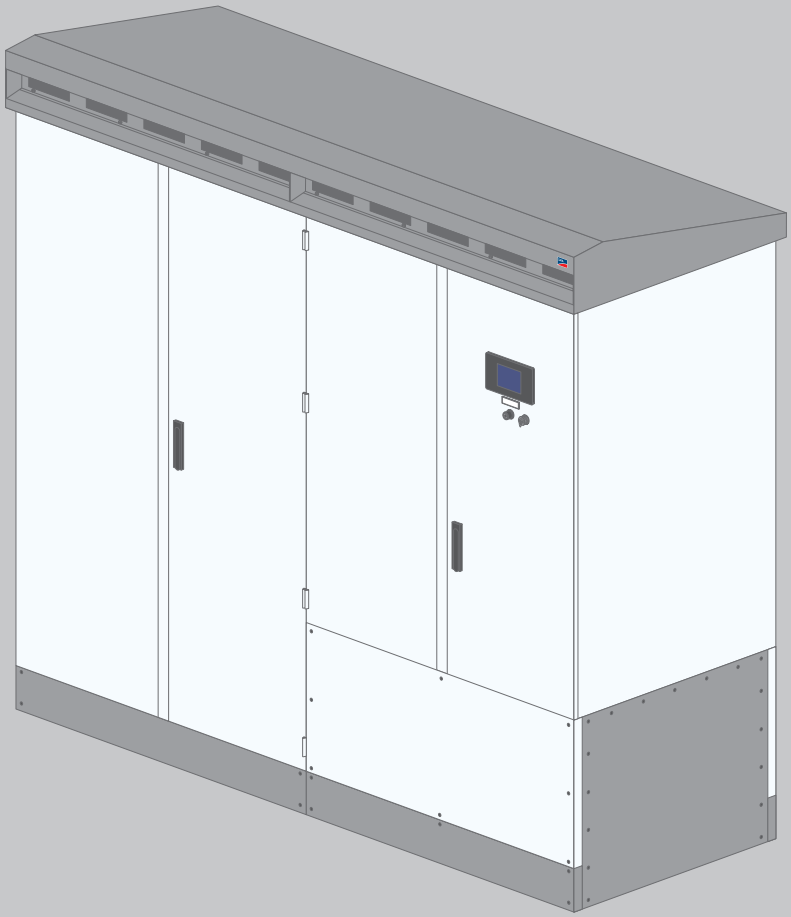
Service Manual for Installers

Test Instructions for the Power-Generating Unit Protection Test SUNNY CENTRAL 500CP XT/630CP XT/720CP XT/ 760CP XT/800CP XT/850CP XT/900CP XT/1000CP XT



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1 Information on this Document

1.1 Validity

This document is valid for the following device types:

Device type	Production version	OCU firmware version	DSP firmware version
SC 500CP-10 (Sunny Central 500CP XT)	E7	01.80.00.R	01.80.00.R
SC 630CP-10 (Sunny Central 630CP XT)			
SC 720CP-10 (Sunny Central 720CP XT)			
SC 760CP-10 (Sunny Central 760CP XT)			
SC 800CP-10 (Sunny Central 800CP XT)			
SC 850CP-10 (Sunny Central 850CP XT)			
SC 900CP-10 (Sunny Central 900CP XT)			
SC 1000CP-10 (Sunny Central 1000CP XT)			

The production version is indicated on the type label.

The firmware version can be read off from the user interface.

Illustrations in this document are reduced to the essential and may deviate from the real product.

1.2 Target Group

The tasks described in this document must only be performed by qualified persons. Qualified persons must have the following skills:

- Knowledge of how the product works and is operated
- Training in how to deal with the dangers and risks associated with installing and using electrical devices and systems
- Training in the installation and commissioning of electrical devices and systems
- Knowledge of all applicable standards and directives
- Knowledge of and adherence to this manual and all safety precautions

1.3 Additional Information

Links to additional information can be found at www.SMA-Solar.com.

1.4 Symbols

Symbol	Explanation
⚠ DANGER	Indicates a hazardous situation which, if not avoided, will result in death or serious injury
⚠ WARNING	Indicates a hazardous situation which, if not avoided, can result in death or serious injury
⚠ CAUTION	Indicates a hazardous situation which, if not avoided, can result in minor or moderate injury
NOTICE	Indicates a situation which, if not avoided, can result in property damage

Symbol	Explanation
ℹ	Information that is important for a specific topic or goal, but is not safety-relevant
☐	Indicates a requirement for meeting a specific goal
☑	Desired result
✖	A problem that might occur

1.5 Typographies

Typographies	Use	Example
bold	• Display messages • Elements on a user interface • Terminals • Slots • Elements to be selected • Elements to be entered	• Set parameter **WGra** to **0.2**.
>	• Connects several elements to be selected	• Select **PV system > Detect**.
[**Button/Key**]	• Button or key to be selected or pressed	• Select [**Start detection**].

1.6 Nomenclature

Complete designation	Designation in this document
Sunny Central	Inverter
Sunny Central Communication Controller	SC-COM or communication unit

2 Safety

2.1 Intended Use

The Sunny Central is a PV inverter which converts the direct current generated in the PV modules into grid-compliant alternating current. An external MV transformer fitted downstream feeds the generated alternating current into the utility grid.

The product is suitable for indoor and outdoor use.

The enclosure complies with degree of protection IP54. The inverter is classified under Class 4C2 as per EN 60721-3-4 and is suitable for operation in a chemically active environment.

The maximum permissible DC input voltage of the inverter must not be exceeded.

The inverter must only be operated in conjunction with a suitable MV transformer.

- The MV transformer must be designed for voltages that arise during pulsed mode of the inverter.
- For the Sunny Central 500CP XT/630CP XT/720CP XT/760CP XT/800CP XT the maximum voltage to ground is: ±1,450 V
- For the Sunny Central 850CP XT/900CP XT/1000CP XT the maximum voltage to ground is: ±1,600 V
- Do not connect more than one inverter to one winding of the MV transformer.
- The neutral conductor on the low-voltage side of the MV transformer must not be grounded.

You can find further information on suitable transformers in the technical information "Requirements for Medium-Voltage Transformers and Transformers for Internal Power Supply for the SUNNY CENTRAL".

Do not deactivate or modify settings that affect grid management services without first obtaining approval from the grid operator.

Use this product only in accordance with the information provided in the enclosed documentation and with the locally applicable standards and directives. Any other application may cause personal injury or property damage.

Alterations to the product, e.g. changes or modifications, are only permitted with the express written permission of SMA Solar Technology AG. Unauthorized alterations will void guarantee and warranty claims and usually void the operating license. SMA Solar Technology AG shall not be held liable for any damage caused by such changes.

Any use of the product other than that described in the Intended Use section does not qualify as appropriate.

The enclosed documentation is an integral part of this product. Keep the documentation in a convenient place for future reference and observe all instructions contained therein.

All work on the product must only be performed using appropriate tools and in compliance with the ESD protection regulations.

Suitable personal protective equipment must be worn by all persons working on or with the product.

Unauthorized persons must not operate the product and must be kept at a safe distance from the product.

The product must not be operated with open covers or doors.

The product must not be opened when it is raining or when humidity exceeds 95%.

The product must not be operated with any technical defects.

The type label must remain permanently attached to the product.

2.2 Safety Information

This section contains safety information that must be observed at all times when working on or with the product. To prevent personal injury and property damage and to ensure long-term operation of the product, read this section carefully and observe all safety information at all times.

⚠ DANGER

Danger to life from electric shock due to live voltage

High voltages are present in the live components of the product. Touching live components results in death or serious injury due to electric shock.

- Wear suitable personal protective equipment for all work on the product.
- Do not touch any live components.
- Observe all warning messages on the product and in the documentation.
- Observe all safety information of the module manufacturer.
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely (see Section 4.2, page 14).

⚠ DANGER

Danger to life from electric shock due to live DC cables

DC cables connected to PV modules that are exposed to sunlight carry live voltage. Touching live cables results in death or serious injury due to electric shock.

- Prior to connecting the DC cables, ensure that the DC cables are voltage-free.
- Wear suitable personal protective equipment for all work on the device.

⚠ DANGER

Danger to life from electric shock due to ground fault

If a ground fault has occurred, parts of the PV power plant that are supposedly grounded may in fact be live. Touching incorrectly grounded parts of the PV power plant results in death or serious injuries from electric shock.

- Before working on the PV power plant, ensure that no ground fault is present.
- Wear suitable personal protective equipment for all work on the device.

⚠ DANGER

Danger to life from electric shock due to damaged product

Operating a damaged product can lead to hazardous situations that result in death or serious injuries due to electric shock.

- Only operate the product when it is in a flawless technical condition and safe to operate.
- Check the product regularly for visible damage.
- Make sure that all external safety equipment is freely accessible at all times.
- Make sure that all safety equipment is in good working order.
- Wear suitable personal protective equipment for all work on the product.

⚠ DANGER

Danger to life from electric shock even if the inverter is disconnected on the AC and DC sides

The precharge unit of the order option "Q at Night" will carry live voltage even if the AC disconnection unit and the DC switchgear are open. Touching live components results in death or serious injury due to electric shock.

- Do not touch any live components.
- Switch off the inverter.
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely.
- Ensure that no voltage is present.
- Do not remove protective covers.
- Observe the warning messages.
- Wear suitable personal protective equipment for all work on the product.

⚠ WARNING

Danger to life from electric shock when entering the PV field

Ground-fault monitoring does not provide protection from personal injury. PV modules which are grounded with ground-fault monitoring discharge voltage to ground. Entering the PV field can result in lethal electric shocks.

- Ensure that the insulation resistance of the PV field exceeds the minimum value. The minimum value of the insulation resistance is: 1 kΩ.
- Before entering the PV field, switch the PV modules to insulated operation.
- Configure the PV power plant as a closed electrical operating area.

⚠ WARNING

Danger to life from electric shock if the product is not locked

If the product is not locked, unauthorized persons will have access to live components carrying lethal voltages. Touching live components can result in death or serious injury due to electric shock.

- Always close and lock the product.
- Remove the keys.
- Store the keys in a safe place.
- Ensure that no unauthorized persons have access to the closed electrical operating area.

⚠ WARNING

Danger to life due to blocked escape routes

In hazardous situations, blocked escape routes can lead to death or serious injury. Opening the doors of two products located opposite each other can block the escape route. It is imperative that the escape route is freely accessible at all times.

- An escape route must be available at all times. Make sure the minimum passage width of the escape route meets local standards.
- Do not place any objects in the escape route area.
- Remove all tripping hazards from escape routes.

⚠ WARNING

Risk of fire due to failure to observe torque specifications on live bolted connections

Failure to follow the specified torques reduces the ampacity of live bolted connections so that the contact resistances increase. This can cause components to overheat and catch fire.

- Ensure that live bolted connections are always tightened with the exact torque specified in this document.
- When working on the device, use suitable tools only.
- Avoid repeated tightening of live bolted connections as this may result in inadmissibly high torques.

⚠ CAUTION

Risk of burns due to hot components

Some components of the product can get very hot during operation. Touching these components can cause burns.

- Observe the warnings on all components.
- During operation, do not touch any components marked with such warnings.
- After switching off the product, wait until any hot components have cooled down sufficiently.
- Wear suitable personal protective equipment for all work on the product.

NOTICE

Property damage due to dust intrusion and moisture penetration

Dust or moisture intrusion can damage the product and impair its functionality.

- Do not open the enclosure during rainfall or when humidity exceeds the specified thresholds. The humidity thresholds are: 15% to 95%.
- Only perform maintenance work when the environment is dry and free of dust.
- Operation of the product is only permitted when it is closed.
- Connect the external supply voltage after mounting and installing the product.
- If the installation or commissioning process is interrupted, mount all panels.
- Close and lock the enclosure.
- The product must always be closed for storage.
- Store the product in a dry and covered location.
- Temperature at the storage location must be in the specified range. The temperature range is: −25°C to +70°C .

NOTICE

Damage to electronic components due to electrostatic discharge

Electrostatic discharge can damage or destroy electronic components.

- Observe the ESD safety regulations when working on the product.
- Wear suitable personal protective equipment for all work on the product.
- Discharge electrostatic charge by touching grounded enclosure parts or other grounded elements. Only then is it safe to touch electronic components.

2.3 Personal Protective Equipment

i Always wear suitable protective equipment

When working on the product, always wear the appropriate personal protective equipment for the specific job.

The following personal protective equipment is regarded to be the minimum requirement:

- ☐ In a dry environment, safety shoes of category S3 with perforation-proof soles and steel toe caps
- ☐ During precipitation or on moist ground, safety boots of category S5 with perforation-proof soles and steel toe caps
- ☐ Tight-fitting work clothes made of 100% cotton
- ☐ Suitable work pants
- ☐ Individually fitted hearing protection
- ☐ Safety gloves

Any other prescribed protective equipment must also be used.

3 Power-Generating Unit Protection Test

The power-generating unit protection test is a fundamental part of PV system certification. For existing systems the protection test is part of the certificate, for new systems it is part of the declaration of conformity. The power-generating unit protection test helps grid operators and the certifying body to understand the proper parameterization and function of the protection concept. To this end, the test procedure must be documented completely. The parameterization specifications and the accuracy class requirements can be found in the grid connection guidelines or are specified by the grid operator.

3.1 Safety during the Power-Generating Unit Protection Test

⚠ DANGER

Danger to life from electric shock due to live voltage

High voltages are present in the live components of the product. Touching live components results in death or serious injury due to electric shock.

- Wear suitable personal protective equipment for all work on the product.
- Do not touch any live components.
- Observe all warning messages on the product and in the documentation.
- Observe all safety information of the module manufacturer.
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely (see Section 4.2, page 14).

3.2 Calculating the Reference Voltage

Contractually agreed voltage V_C corresponds to parameter VRtg

The contractually agreed voltage at the grid feed-in point V_C corresponds to the parameter **VRtg**. V_C – the voltage contractually agreed on with the electric utility company – must be entered for the parameter **VRtg** during commissioning and calculation of the reference voltage.

An appropriate reference voltage must be selected for the testing device when performing the protection test. The reference voltage can be calculated using the following formula.

$$V_0 = V_C \cdot \frac{1}{i} = VRtg \cdot \left(\frac{TrfVolExLo}{TrfVolExHi} \right)$$

Formula Symbol	Unit	Explanation
V_0	V	Reference voltage of testing device
V_C	V	Voltage at the grid feed-in point, contractually agreed with the grid operator
i	-	Transmission ratio of the MV transformer. The transmission ratio is the ratio of **TrfVolExLo** to **TrfVolExHi**.
VRtg*	V	Nominal line voltage of the utility grid (parameter)

Formula Symbol	Unit	Explanation
TrfVolExLo**	V	Voltage on the low-voltage side of the external transformer (parameter)
TrfVolExHi**	V	Voltage on the high-voltage side of the external transformer (parameter)

* This parameter takes the level of the medium voltage into account. V_C, the voltage at the grid feed-in point as contractually agreed with the grid operator, must be entered for **VRtg**.

** These parameters take the transformation ratio of the tap changer of the MV transformer into account. During commissioning, the tap changer is adjusted in such way that the terminal voltage of the MV transformer matches the nominal voltage of the inverter as closely as possible.

3.3 Saving the Test Parameters

The inverters have two relevant parameter pairs each for voltage increase protection and voltage drop protection and one relevant pair of parameters for frequency increase protection and frequency drop protection.

		Setting value / operating time
Voltage increase protection	1st level: V> / $t_{V>}$	VCtlhLim / VCtlhLimTm
	2nd level: V>> / $t_{V>>}$	VCtlhhLim / VCtlhhLimTm
Voltage drop protection	1st level: V< / $t_{V<}$	VCtllLim / VCtllLimTm
	2nd level: V<< / $t_{V<<}$	VCtlllLim / VCtlllLimTm
Frequency increase protection	1st level: f> / $t_{V>}$	HzCtlhLim / HzCtlhLimTm
Frequency drop protection	1st level: f< / $t_{V<}$	HzCtllLim / HzCtllLimTm

Access to parameters

The parameters needed for the power-generating unit protection test are only accessible after the installer password has been entered. The installer password is changed during the initial installation. You can obtain the changed installer password from the PV system operator. The default password can be found in the operating manual.

Procedure:

1. Log into the user interface.
2. Select **PV system > Devices**.
3. Select .
   ☑ A list of the existing device types appears.
4. Select the desired device type.
   ☑ A list appears containing all existing devices of this type.
5. Select the desired device from the list.
6. Select the tab **Parameters**.
7. Save the test parameter values.

3.4 Performing the Power-Generating Unit Protection Test

Materials required for test:

☐ Three-phase testing device with the following properties:
- Trigger function for monitoring the potential-free contact
- Voltage range up to 530 V_{AC} (line-to-line) with accuracy better than 0.1%

  - Logging function

☐ Measurement cables

☐ Laptop for changing the inverter parameters

Requirements:

☐ The relevant test parameters have been saved (see Section 3.3, page 12).

☐ The tap changer setting on the MV transformer complies with the specifications of the grid operator or the PV system certificate.

☐ The parameter settings comply with the specifications of the grid operator or the PV system certificate.

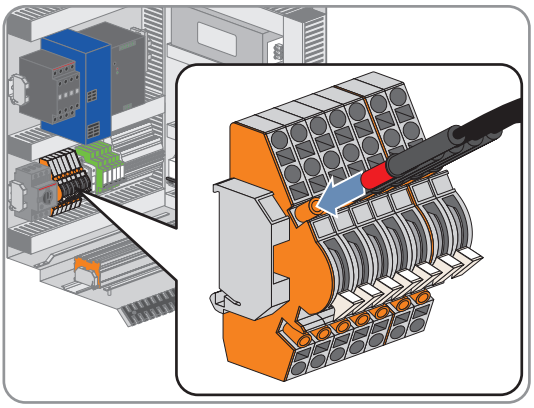
⚠ DANGER

Danger to life due to electric shock or electric arc if live components are touched

- Switch off the inverter and wait at least 15 minutes before opening it to allow the capacitors to discharge completely.
- Disconnect the inverter (see Section 4, page 14).

Procedure:

1. Identify the measurement and disconnect terminal using the circuit diagram and reference designation.
2. Connect the outputs L1, L2 and L3 of the testing device to the measurement inputs P1, P2 and P3 on the measurement and disconnect terminals of the voltage measurement unit.



3. Connect the binary input of the testing device to the measurement inputs P5 and P6 on the measurement and disconnect terminals of the voltage measurement unit.
4. Connect the testing device to the external voltage supply.
5. Connect the laptop to the service interface.
6. Log into the user interface as an installer.
7. Perform the power-generating unit protection test in accordance with the TR8 data request form. Set the test parameters in accordance with the specifications of the grid operator or the PV system certificate.
   - Voltage increase protection V> / $t_{V>}$ with the parameters **VCtlhLim** and **VCtlhLimTm**
   - Voltage increase protection V>> / $t_{V>>}$ with the parameters **VCtlhhLim** and **VCtlhhLimTm**
   - Voltage drop protection V< / $t_{V<}$ with the parameters **VCtllLim** and **VCtllLimTm**
   - Voltage drop protection V<< / $t_{V<<}$ with the parameters **VCtlllLim** and **VCtlllLimTm**
   - Frequency increase protection f> / $t_{V>}$ with the parameters **HzCtlhLim** and **HzCtlhLimTm**
   - Frequency drop protection f<< / $t_{V<<}$ with the parameters **HzCtllLim** and **HzCtllLimTm**
8. Remove the measurement cables from the measurement and disconnect terminals.
9. Reconnect the inverter (see Section 4.3, page 16).

4 Disconnecting and Reconnecting

4.1 Safety When Disconnecting and Reconnecting Voltage Sources

⚠ DANGER

Danger to life from electric shock due to live voltage

High voltages are present in the live components of the product. Touching live components results in death or serious injury due to electric shock.

- Wear suitable personal protective equipment for all work on the product.
- Do not touch any live components.
- Observe all warning messages on the product and in the documentation.
- Observe all safety information of the module manufacturer.
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely (see Section 4.2, page 14).

⚠ DANGER

Danger to life from electric shock due to ground fault

If a ground fault has occurred, parts of the PV power plant that are supposedly grounded may in fact be live. Touching incorrectly grounded parts of the PV power plant results in death or serious injuries from electric shock.

- Before working on the PV power plant, ensure that no ground fault is present.
- Wear suitable personal protective equipment for all work on the device.

⚠ CAUTION

Risk of burns due to hot components

Some components of the product can get very hot during operation. Touching these components can cause burns.

- Observe the warnings on all components.
- During operation, do not touch any components marked with such warnings.
- After switching off the product, wait until any hot components have cooled down sufficiently.
- Wear suitable personal protective equipment for all work on the product.

4.2 Disconnecting the Inverter

4.2.1 Switching off the Inverter

1. Turn the key switch to **Stop**.
2. Remove the key. This will protect the inverter from inadvertent reconnection.
3. Wait 15 minutes before opening the doors. This allows the inverter capacitors to discharge.

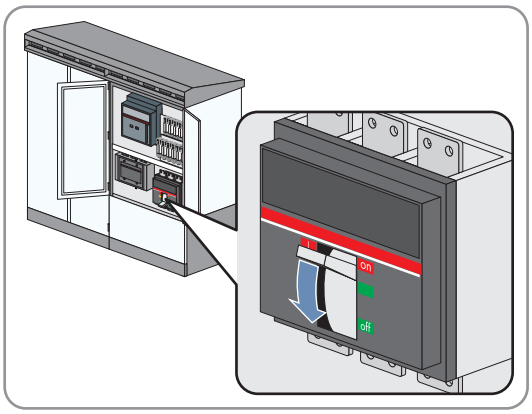
4.2.2 Disconnecting the DC Side

1. Switch off the inverter (see Section 4.2.1, page 14).
2. Disconnect all poles of the DC voltage in the DC main distribution or DC subdistribution (see documentation of the main or subdistribution).
3. Ensure that the DC switchgear in the inverter is open.
4. Ensure that no voltage is present on the load side of the DC switchgear.

5. Cover or isolate any adjacent live components.
6. Remove the protective covers over the fuses.
7. Remove all fuses and disconnection blades from all fuse holders of the inverters. Use an LV/HRC fuse extractor.

4.2.3 Disconnecting the AC Side

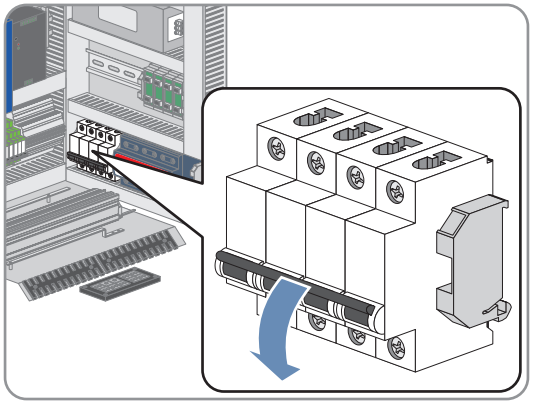
1. Switch off the inverter (see Section 4.2.1, page 14).
2. Disconnect the DC side (see Section 4.2.2, page 14).
3. Externally disconnect the AC voltage of the MV transformer.
4. Switch off the AC disconnection unit in the inverter.



5. Ensure that no voltage is present.
6. Cover or isolate any adjacent live components.

4.2.4 Disconnecting the Supply Voltage and External Voltages

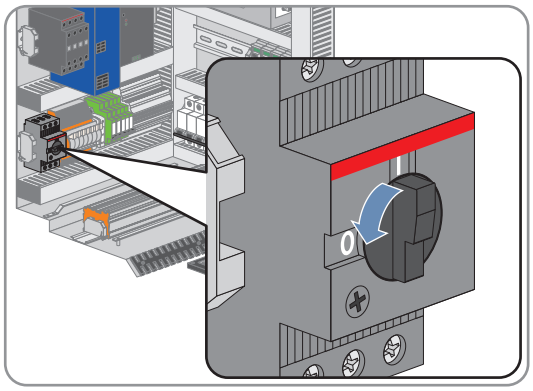
1. If the supply voltage is only to be disconnected upstream from the circuit breaker, switch the circuit breaker of the supply voltage off.



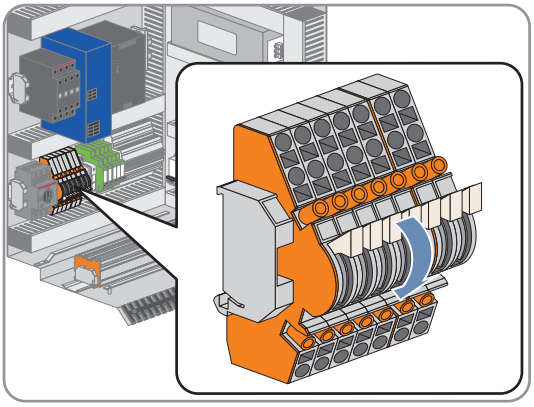
2. If the supply voltage is also to be disconnected downstream from the supply voltage circuit breaker, switch the external circuit breaker of the supply voltage off.

   Tip: The external circuit breaker of the supply voltage is usually located in a subordinate distribution station.
3. Disconnect any additional external voltage.

4. Switch the motor-protective circuit-breakers of the grid monitoring off.



5. Open the measurement and disconnect terminals.

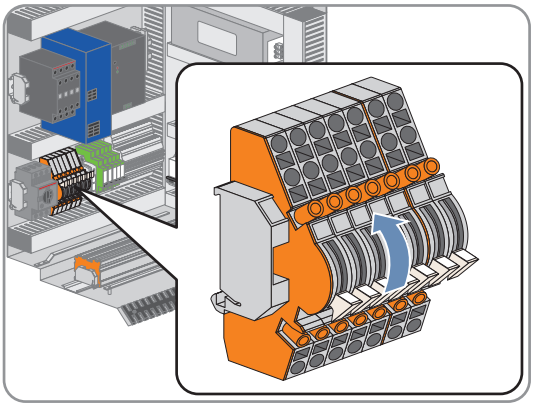


6. Ensure that no voltage is present.
7. Cover or isolate any adjacent live components.

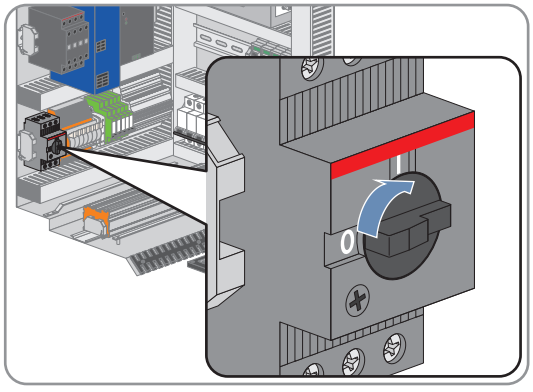
4.3 Reconnecting the Inverter

4.3.1 Reconnecting the Supply Voltage and External Voltages

1. Close the measurement and disconnect terminals.

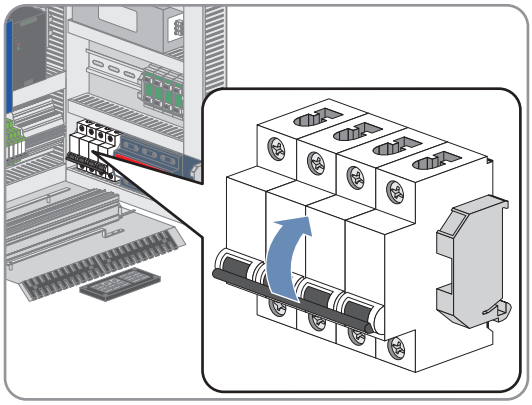


2. Switch on the motor-protective circuit-breakers of the grid monitoring.



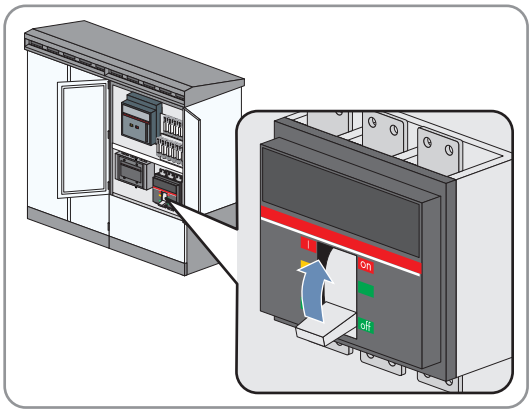
3. Connect any additional external voltage.
4. If the supply voltage has been disconnected downstream from the circuit breaker, switch the external circuit breaker of the supply voltage on.

   Tip: The external circuit breaker of the supply voltage is usually located in a subordinate distribution station.
5. If the supply voltage has been disconnected upstream from the circuit breaker, switch the circuit breaker of the supply voltage on.



4.3.2 Reconnecting the AC Side

1. Reconnect the supply voltage and external voltages (see Section 4.3.1, page 16).
2. Reconnect the AC voltage of the MV transformer.
3. Switch on the AC disconnection unit in the inverter.



4.3.3 Reconnecting the DC Side

1. Insert all fuses and disconnection blades into all fuse holders of the inverter. Use an LV/HRC fuse extractor.
2. Screw on the protective covers over the fuses (torque: 5 Nm).
3. Switch on the DC voltage in the DC main distribution or DC subdistribution (see documentation of the main or subdistribution).

4.3.4 Restarting the Inverter

- Turn the key switch to **Start**.

5 Contact

If you have technical problems with our products, please contact the SMA Service Line. We need the following information in order to provide you with the necessary assistance:

- Device type
- Serial number
- Type and number of PV modules connected
- Type of communication
- Error number and error message

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